In the specification:

Please amend the specification as follows:

[0010] A method of maintaining the predetermined minimum voltage level is also provided including generating a load signal. A high-voltage mode is performed when the load signal is greater than a predetermined load and a first direction signal is generated. A low-voltage mode is performed when the load signal is less than or equal to a predetermined load and a second direction signal is generated. A bi-directional switch is switched to an open state in response to the first direction signal and to a closed state in response to [[a]]the second direction signal. An up-conversion is performed in response to the first direction signal and a down-conversion is performed in response to the second direction signal to maintain a predetermined minimum voltage level on the high-voltage load.

[0011] One of several advantages of the present invention is that it provides an apparatus and method for maintaining a minimum voltage level of 30 volts across high-voltage loads of a soft hybrid-electric vehicle~~. Thereby~~, thereby allowing high-voltage loads to operate accordingly during engine high-loading periods.

[0021] The supply circuit 14 includes an integrated starter generator (ISG) control circuit 20 electrically coupled to an ISG 22, which supplies power to the engine 18 as needed. The supply circuit 14 also includes a converter circuit 24 electrically coupled to the control circuit 20, a high-voltage bus 26, and a low-voltage bus 28. The converter circuit 24 maintains a predetermined voltage level on high-voltage loads 30 during vehicle engine high-loading periods. The high-voltage loads may be 42-volt loads having an approximate minimum voltage requirement of 30 volts. Low-voltage loads 32 obtain power from the low-voltage bus 28, which is supplied by low-voltage device 35, as shown in Figure 2. The low-voltage loads operate at approximately 12-14 volts.

[0022] Vehicle engine high-loading periods may include starting of the engine 18 and acceleration of the vehicle 12, as well as other high-loading conditions. The acceleration of the vehicle 12 in and of itself may include the following described scenarios having corresponding high-voltage modes. One possible scenario is when the vehicle 12 is accelerated during normal driving conditions in which the circuit 20 and engine controller 16 operate in a boost mode. In [[an]] addition, the vehicle 12 may be accelerated at a higher rate, which requires additional power, from a standstill for which the circuit 20 and engine controller 16 operate in a launch assist mode. Another possible scenario is when vehicle 12 is ~~re-start~~re-started during a standstill. During a standstill, such as in high traffic situations, the engine 18 is powered "OFF" to conserve energy. Upon determination to accelerate the vehicle 12 the engine 18 is re-powered "ON" to accelerate the vehicle 12 in which the circuit 20 and engine controller 16 operate in an idle/start mode. Other possible high-loading scenarios known in the art may also be incorporated.

[0024] Referring now to Figure 2, a schematic diagram of a soft hybrid-electric vehicle power supply circuit 14 for the vehicle 12 in accordance with an embodiment of the present invention is shown. The supply circuit 14 includes a high-voltage energy storage device 34 with open circuit voltage at around 36 volts and operating at approximately 42 volts when the ISG is operating, and a low-voltage energy storage device 35 with open circuit voltage at approximately 12 volts and operating at approximately 14 volts when the converter circuit 24 is operating.

[0026] The control circuit 20 includes an inverter 38 and an ISG controller 40. The inverter 38 processes power in order to operate ISG 22. Inverter 38 transfers and converts electrical power between the high-voltage bus 26 and the ISG 22. The inverter 38 transfers electrical power from the high-voltage bus 26 to the ISG 22 when the ISG 22 is operating as a motor. The inverter 38 converts electrical power from the ISG 22 to the high-voltage bus when the ISG 22 is

operating as a generator. The ISG controller 40 determines when to convert the electrical power [[or]]to the mechanical power, in response to whether the system 10 is operating in a high-loading period or is supplying electrical power to the high-voltage bus 26, respectively. In turn, the ISG controller 40 determines whether system 10 is to operate in a high-voltage mode or a low-voltage mode in response to the load signal received by the engine controller 16.

[0027] The converter circuit 24 includes a bi-directional switch 42 and a bi-directional converter 44. The converter 44 is electrically coupled to the switch 42 and includes internal voltage sensors 62. The operation of the bi-directional switch 42 can be controlled by ~~either~~ converter 44, the control circuit 20, the engine controller 16, or a separate controller that has access to the load signal 19. The converter 44 controls direction of voltage conversion from either the high-voltage bus 26 to the low-voltage bus 28 or from the low-voltage bus 28 to the high-voltage bus 26 to maintain the predetermined minimum voltage level on the high-voltage load 30, which is represented by arrows 46.

[0032] In step 52, the ISG controller 40 determines whether the system 10 is to perform a high-voltage mode or a low-voltage mode. The ISG controller 40 determines a high-voltage mode when the load signal is greater than a predetermined load and generates a first direction signal and determines a low-voltage mode when the load signal is less than or equal to a predetermined load and generates a second direction signal. The high-voltage mode ~~applying~~ applies to up-conversion from the low-voltage bus 28 to the high-voltage bus 26. The low-voltage mode ~~applying~~ applies to down-conversion from the high-voltage bus 26 to the low-voltage bus 28. The ISG controller 40 signals the engine controller 16 and the converter 44 upon determining whether the system 10 is to perform a high-voltage mode or a low-voltage mode.

[0035] In step 58, the converter 44 switches the switch 42 to a closed state in response to the second direction signal to perform a down-conversion. Upon completion of either step 56 or step 58 the converter circuit 24 may generate a

converter circuit status signal indicating the status of the converter circuit 24, such as the state of the switch 42 or the status of the converter 44.

[0037] In step 54, parameters for the up-conversion are determined to maintain a predetermined minimum voltage level on the high-voltage load. The converter 44 determines when to perform the voltage conversion, a power rating to apply for the voltage conversion, and duration of time to perform the voltage conversion and generates a voltage conversion signal using the internal voltage sensors 62.

[0038] The converter 44 in switching the switch 42 and performing a voltage conversion decouples the high-voltage loads 30 from the high-voltage bus 26 and couples the high-voltage loads 30 to the low-voltage bus 28 during vehicle engine high-loading periods, when the switch 42 is open. The engine controller 16 signals the engine 18 to draw power from the high-voltage bus 26 in response to the converter circuit status signal. During normal-loading periods the converter 44 also couples the high-voltage loads 30 to the high-voltage bus 26 and decouples the high-voltage loads 30 from the low-voltage bus 28, when the switch 42 is closed.

[0040] The above-described apparatus, to one skilled in the art, is capable of being adapted for various purposes and is not limited to the following systems: automotive vehicle systems, control systems, hybrid-electric vehicle systems, or other applications ~~containing~~ requiring the maintenance of a predetermined minimum voltage. The above-described invention may also be varied without deviating from the spirit and scope of the invention as contemplated by the following claims.